CONTENTS

SECTION I: CHAPTER 4
TECHNICAL EQUIPMENT

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TECHNICAL EQUIPMENT

A. INTRODUCTION

Each person to whom technical equipment is assigned is responsible for ensuring that the equipment is properly maintained and calibrated according to Division schedules.

This chapter discusses the types, calibration, maintenance, and operation of equipment commonly used by Division personnel in the field. It is not a comprehensive discussion of all available equipment nor a review of technical equipment.
Mention of a specific product is not meant to imply approval or promotion by the Division, but merely indicates an example.

Some technical equipment can be connected to a computer for calculations and print-outs. Consult the manufacturer's manual or call the CALICO Laboratory.

B. CALIBRATION

The CALICO Laboratory calibrates and repairs equipment and instruments, and it serves as a source of technical information on instruments and measurement technology.

SHIPPING INSTRUCTIONS

Equipment shall be packed and sent to CALICO when repairs are necessary or calibration is due. Send **all** parts of the instrument, not just those needing repairs. If the instrument needs repairs or any special attention, include all transfer documents and forms with the instrument stating the associated problem as clearly as possible. Call CALICO, if there are any questions.

- Equipment needing regular calibration by CALICO is listed in Appendix I:3-1.
- Send the Maintenance and Calibration Instrument Service Request and Transfer Form in each box of equipment, and list the equipment in that box.
    - Use one line per item
    - Enter the instrument's description, the manufacturer's code, model code, and serial number.

- Enter the return address.

- List repairs needed and special instructions on a tag or note attached to the instrument.

- Place the equipment in a clean plastic bag. Packing material should be polystyrene foam, polyurethane foam, or crumpled newspaper. **Do not use** vermiculite, wood-chips, or other fibrous or powdery material that may create fine dust, and clog the instrument(s).

- After consultation with CALICO equipment contaminated with toxic chemicals must be double-wrapped in plastic bags, and each bag sealed separately with tape or twisted wire. A tag must be attached to the outside bag with the words:

  To be decontaminated.
  Contaminated with
  (name of compound)

POSTAL REGULATIONS

Packages to be shipped by the postal service cannot exceed 100 inches in length plus girth or 40 pounds in weight. All markings (old registration, certification, addresses, etc.) must be removed from reused shipping containers or covered so that only new markings are visible.

SPECIAL INSTRUCTIONS

Instruments requiring repair or special instructions must be tagged with the symptoms of the malfunction and/or the special instruction written on the tag. The special instructions in Appendix I:3-2 may apply. All toxic materials must be marked and the carrier informed.

CALICO has specialized equipment in addition to that described here. This equipment is available on loan. Contact CALICO directly for all loans.

The CALICO Laboratory in Oakland may sometimes have specialized equipment such as ozone meters, portable gas chromatographs, radon and bioaerosol monitors available for field use. Contact CALICO for further information.

C. BATTERIES

ALKALINE BATTERIES

Replace frequently (once a month) or carry fresh replacements.

RECHARGEABLE NI-CAD BATTERIES

Check the batteries under load (e.g., turn pump on and check voltage at charging jack) before use. See manufacturers' instructions for locations to check voltage. Use 1.3-1.4 volts per Ni-Cad cell for an estimate of the fully charged voltage of a rechargeable battery pack.

It is undesirable to discharge a multicell Ni-Cad battery pack to voltage levels that are 70% or less of its rated voltage—doing this will drive a reverse current through some of the cells and can permanently damage them. When the voltage of the battery pack drops to 70% of its rated value, it is considered depleted and should be recharged.

Rechargeable Ni-Cad batteries should be charged only in accordance with manufacturer's instructions. Chargers are generally designed to charge batteries quickly (approximately 8 to 16 hours) at a high charge rate or slowly (trickle charge). A battery can be overcharged and ruined when a high charge rate is applied for too long a time. However, Ni-Cad batteries may be left on trickle charge indefinitely to maintain them at peak capacity. In this case, discharging for a period equal to the longest effective field service time may be necessary, because of short-term memory imprinting.

D. ADVERSE CONDITIONS

ADVERSE TEMPERATURE EFFECTS

High ambient temperature, above 100°F and/or radiant heat (e.g., from nearby molten metal) can cause flow faults in air sampling pumps.

If these conditions are likely, use the pump with a higher operating temperature range (e.g., Dupont Alpha-1) as opposed to a pump with a lower operating temperature range (e.g., SKC).

EXPLOSIVE ATMOSPHERES

Instruments shall not be used in atmospheres where the potential for explosion exists (see Ref. T8CCR 2540.2) unless the instruments is intrinsically safe or certified by the Mine Safety and Health Administration (MSHA), Underwriter's Laboratory (UL), Factory Mutual (FM) or other testing laboratory recognized by the Division for the type of atmosphere present.

When batteries are being replaced, use only the type of battery specified on the safety approval label (i.e., carbon/zinc for flashlights).

Do not assume that an instrument is intrinsically safe. Verify by contacting the instrument's maker or CALICO if uncertain.

ATMOSPHERES CONTAINING CARCINOGENS

A plastic bag should be used to cover equipment when carcinogens are present.

Decontamination procedures for special environments are available through the Regional Sr. IH and should be followed after using equipment in carcinogenic environments.

E. DIRECT-READING INSTRUMENTS

MERCURY ANALYZER-GOLD FILM ANALYZER

Description And Application

A gold-film analyzer draws a precise volume of air over a gold-film sensor. A microprocessor computes the concentration of mercury in milligrams per cubic meter and displays the results on the digital meter.

The meter is selective for mercury and eliminates interference from water vapor, sulfur dioxide, aromatic hydrocarbons, and particulates.

Calibration

Calibration should be performed by the manufacturer or a laboratory with the special facilities to generate known concentration of mercury vapor, at least annually.

Instruments should be returned to the manufacturer or a calibration laboratory on a scheduled basis.

Special Considerations

In high concentrations of mercury vapor the gold film saturates quickly. It should not be used for concentrations expected to be over 1.5 milligrams per cubic meter. Hydrogen sulfide is an interferant (be sure the Hydrogen Sulfide filter is in place and functional).

Maintenance

Mercury vapor instruments generally contain rechargeable battery packs, filter medium, pumps and valves which require periodic maintenance.

Except for routine charging of the battery pack, most periodic maintenance will be performed during the scheduled annual calibrations.

Note: It is important to run the instrument to “exercise” it at least monthly! Records should be maintained.

OZONE METER

Description and Application

The detector uses a thin-film semiconductor sensor. A thin-film platnum heater is formed on one side of an alumina substrate. A thin-film platinum electrode is formed on the other side, and a thin-film semiconductor is formed over the platinum electrode by vapor deposition. The semiconductor film, when kept at a high temperature by the heater, will vary in resistance due to the absorption and decomposition of ozone. The change in resistance is converted to a change of voltage by the constant-current circuit.

The measuring range of the instrument is 0.01 ppm to 9.5 ppm ozone in air. The readings are displayed on a liquid crystal display that reads ozone concentrations directly. The temperature range is 0°-40°C, and the relative humidity range is 10%-80% RH.

Calibration

Calibrate instrument before and after each use. Be sure to use a well-ventilated area since ozone levels may exceed the PEL for short periods.
Calibration requires a source of ozone. Controlled ozone concentrations are difficult to generate in the field, and this calibration is normally performed at CALICO.

Gas that is either specially desiccated or humidified must not be used for preparing calibration standards, as readings will be inaccurate.

Special Considerations

The instrument is not intrinsically safe.

The instrument **must not** be exposed to water, rain, high humidity, high temperature, or extreme temperature fluctuation.

The instrument **must not** be used or stored in an atmosphere containing silicon compounds, or the sensor will be poisoned.

The instrument **is not** to be used for detecting gases other than ozone. Measurements **must not** be performed when the presence of organic solvents, reducing gases (such as nitrogen monoxide, etc.), or smoke is suspected; readings may be low.

Maintenance

The intake-filter unit-Teflon™ sampling tube should be clean and connected firmly. These should be checked before each operation.

Check pump aspiration and sensitivity before each operation.

TOXIC GAS METERS

Description And Application

This analyzer uses an electrochemical voltametric sensor or polarographic cell to provide continuous analyses and electronic recording.

In operation, sample gas is drawn through the sensor and adsorbed on an electrocatalytic sensing electrode, after passing through a diffusion medium. An electrochemical reaction generates an electric current directly proportional to the gas concentration. The sample concentration is displayed directly in parts per million. Since the method of analysis is not absolute, prior calibration against a known standard is required. Exhaustive tests have shown the method to be linear, thus, calibration at a single concentration is sufficient.

Types-Sulfur dioxide, hydrogen cyanide, hydrogen chloride, hydrazine, carbon monoxide, hydrogen sulfide, nitrogen oxides, chlorine, ethylene oxide, formaldehyde. Can be combined with combustible gas and oxygen meters.

Calibration

Calibrate the direct-reading gas monitor before and after each use in accordance with the manufacturer's instructions and with the appropriate calibration gas.

Special Considerations

Interference from other gases can be a problem. See manufacturer literature.

When calibrating under external pressure, the pump must be disconnected from the sensor to avoid sensor damage. If the span gas is directly fed into the instrument from a regulated pressurized cylinder, the flow rate should be set to match the normal sampling rate.

Due to the high reaction rate of the gas in the sensor, substantially lower flow rates result in lower readings. This high reaction rate makes rapid fall time possible simply by shutting off the pump. Calibration from a sample bag connected to the instrument is the preferred method.

PHOTOIONIZATION METERS

Description And Applications

Ionization is based upon making a gas conductive by the creation of electrically charged atoms, molecules, or electrons and the collection of these charged particles under the influence of an applied electric field.

The photoionization analyzer is a screening instrument used to measure a wide variety of organic and some inorganic compounds. It is also useful as a leak detector.

The limit of detection for most contaminants is approximately 0.1 ppm. The instrument has a hand-held probe.

Calibration

A rapid procedure for calibration involves bringing the probe close to the calibration gas and checking the instrument reading.

For precise analyses it is necessary to calibrate the instrument with the specific compound of interest. The calibration gas should be prepared in air.

Special Considerations

The specificity of the instrument depends on the sensitivity of the detector to the substance being measured, the number of interfering compounds present, and the concentration of the substance being measured relative to any interferences.

Some instruments are approved by Factory Mutual(FM) to meet the safety requirements of Class 1, Division 2, hazardous locations of the National Electrical Code (NEC).

Maintenance

Keeping these instruments in top operating shape means charging the battery, cleaning the ultraviolet lamp window and light source, and replacing the dust filter.

The exterior of the instrument can be wiped clean with a damp cloth and mild detergent if necessary. Keep the cloth away from the sample inlet, however, and do not attempt to clean while the instrument is connected to line power.

INFRARED ANALYZERS

Description and Applications

The infrared analyzer has been used within the Division as a screening tool for a number of gases and vapors and is presently the recommended screening method for substances with no feasible sampling and analytical method. See Chemical Sampling Information in OCIS or the Chemical Information Manual for specific substances.

These analyzers are often factory-programmed to measure many gases and are also user-programmable to measure other gases.

A microprocessor automatically controls the spectrometer, averages the measurement signal, and calculates absorbance values. Analysis results can be displayed either in parts per million (ppm) or absorbance units (AU).

The variable path-length gas cell give the analyzer the capability of measuring concentration levels from below 1 ppm up to percent levels.

Some typical screening applications are:

- carbon monoxide and carbon dioxide, especially useful for indoor air assessments;
- anesthetic gases including, e.g., nitrous oxide, halothane, enflurane, penthrane, and isoflurane;
- ethylene oxide; and
- fumigants including, e.g., ethylene dibromide, chloropicrin, and methyl bromide.

Calibration

The analyzer and any strip-chart recorder should be calibrated before and after each use in accordance with the manufacturer's instructions.

Special Considerations

The infrared analyzer may be only semispecific for sampling some gases and vapors because of interference by other chemicals with similar absorption wavelengths.

Maintenance

No field maintenance of this device should be attempted except items specifically detailed in the instruction book such as filter replacements and battery charging.

DIRECT-READING DUST MONITORS

Condensation Nuclei

Description and Applications

Condensation-nuclei counters are based upon a miniature, continuous-flow condensation nucleus counter (CNC) that takes particles too small to be easily detected, enlarges them to a detectable size, and counts them. Submicrometer particles are grown to supermicrometer alcohol droplets by first saturating the particles with alcohol vapor as they pass through a heated saturator lined with alcohol soaked felt, and then condensing the alcohol on the particles in a cooled condenser. Optics focus laser light into a sensing volume.

As the droplets pass through the sensing volume, the particles scatter the light. The light is directed onto a photodiode which generates an electrical pulse from each droplet. The concentration of particles is counted by determining the number of pulses generated.

The counter counts individual airborne particles from sources such as smoke, dust, and exhaust fumes. It operates in three modes, each with a particular application. In the "count" mode, the counter measures the concentration of these airborne particles. In the "test" (or fit test) mode, measurements are taken inside and outside a respirator and a fit factor is calculated. In the "sequential" mode, the instrument measures the concentration on either side of a filter and calculates filter penetration.

This instrument is sensitive to particles as small as 0.02 micrometers. However, it is insensitive to variations in size, shape, composition, and refractive index.

Calibration

Calibrate the counter before and after each use in accordance with the manufacturer's instructions.

Special Considerations

Because of regulations on shipment of flammable liquid, reagent-grade isopropyl alcohol may have to be purchased locally and used to refill the small plastic alcohol-fill tubes provided with the instrument. CALICO also stocks and ships this alcohol. For long-term storage (over 14 days), follow the steps listed below:

- dry the saturator belt by installing a freshly charged battery pack without adding alcohol. Allow the instrument to run until the LO message (low battery) or the E—E message (low particle count) appears;

- remove the battery pack from the instrument (i.e. Portacount): and

- install the tube plugs into the ends of the twintube assembly.

Maintenance

Isopropyl alcohol must be added to the unit every 5-6 hours of operation, per the manufacturer's instructions. Take care not to overfill the unit.

Under normal conditions, a fully charged battery pack will last for about 5 hours of operation. Low battery packs should be charged for at least 6 hours, and battery packs should not be stored in a discharged condition.

Photodetection

Description and Applications

Photodetectors operate on the principle of the detection of scattered electromagnetic radiation in the near infrared.

Photodetectors can be used to monitor total and respirable particulates. The device measures the concentration of airborne particulates and aerosols including dust, fumes, smoke, fog, mist, etc.

Calibration

Factory calibration is adequate.

Special Considerations

Certain instruments have been designed to satisfy the requirements for intrinsically safe operation in methane-air mixtures.

Maintenance

When the photodetector is not being operated, it should be placed in its plastic bag, which should then be closed. This will minimize the amount of particle contamination of the inner surfaces of the sensing chamber.

After prolonged operation in or exposure to particulate-laden air, the interior walls and the two glass windows of the sensing chamber may have become contaminated with particles. Although repeated updating of the zero following the manufacturer's procedures will correct errors resulting from such particle accumulations, this contamination could affect the accuracy of the measurements as a result of excessive spurious scattering and significant attenuation to the radiation passing through the glass windows of the sensing chamber.

COMBUSTIBLE GAS METERS

Description and Applications

These meters use a platinum element as an oxidizing catalyst. The platinum element is one leg of a Wheat-stone bridge circuit. These meters measure gas concentration as a percentage of the lower explosive limit of the calibrated gas.

The oxygen meter displays the concentration of oxygen in percent by volume measured with a galvanic cell.

Other electrochemical sensors are available to measure carbon monoxide, hydrogen sulfide, and other toxic gases.

Some units have an audible alarm that warns of low oxygen levels or malfunction.

Calibration

Before using the monitor each day, calibrate the instrument to a known concentration of combustible gas (usually methane) equivalent to 25-50% LEL full-scale concentration.

The monitor **must be calibrated to the altitude** at which it will be used. Changes in total atmospheric pressure from changes in altitude will influence the instrument's measurement of the air's oxygen content.

The unit's instruction manual provides additional details on calibration of sensors.

Special Considerations

Silicone compound vapors, leaded gasoline, and sulfur compounds will cause desensitization of the combustible sensor and produce erroneous (low) readings.

High relative humidity (90%-100%) causes hydroxylation, which reduces sensitivity and causes erratic behavior including inability to calibrate.

Oxygen deficiency or enrichment such as in steam or inert atmospheres will cause erroneous readings for combustible gases.

In drying ovens or unusually hot locations, solvent vapors with high boiling points may condense in the sampling lines and produce erroneous (low) readings.

High concentrations of chlorinated hydrocarbons such as trichloroethylene or acid gases such as sulfur dioxide will depress the meter reading in the presence of a high concentration of combustible gas.

High-molecular-weight alcohols can burn out the meter's filaments.

If the flash point is greater than the ambient temperature, an erroneous (low) concentration will be indicated.

If the closed vessel is then heated by welding or cutting, the vapors will increase and the atmosphere may become explosive.

For gases and vapors other than those for which a device was calibrated, users should consult the manufacturer's instructions and correction curves.

Maintenance

The instrument requires no short-term maintenance other than regular calibration and recharging of batteries.

Use a soft cloth to wipe dirt, oil, moisture, or foreign material from the instrument.

Check the bridge sensors periodically, at least every six months, for proper functioning.

A thermal combustion-oxygen sensor uses electrochemical cells to measure combustible gases and oxygen. It is not widely used in the area offices.

OXYGEN METERS

These oxygen-measuring devices can include coulometric and fluorescence measurement, paramagnetic analysis, and polarographic methods.

DOSH ALARM SET POINTS TABLE

(Based on T8 Section 5155, Table AC-1)

SENSORS	VALUE	LOW	HIGH	STEL	CEILING	8-HOUR TWA	PEL
O_2	%	19.5	23.5*				19.5/23.5

*The Minigard III O2 maximum setting is 23.0%

F. BIOAEROSOL MONITORS

DESCRIPTION AND APPLICATIONS

A bioaerosol meter, usually a two-stage sampler, is also a multiorifice cascade impactor. This unit is used when size distribution is not required and only respirable-nonrespirable segregation or total counts are needed.

Ninety-five to 100% of viable particles above 0.8 microns in an aerosol can be collected on a variety of bacteriological agar. Trypticase soy agar is normally used to collect bacteria and malt extract agar is normally use to collect fungi. They can be used in assessing sick-(tight-) building syndrome and mass psychogenic illness.

These samplers are also capable of collecting virus particles. However, there is no convenient, practical method for cultivation and enumeration of these particles.

CALIBRATION

Bioaerosol meters must be calibrated before use. This can be done using an electronic calibration system with a high-flow cell, available through the HRT.

SPECIAL CONSIDERATIONS

Prior to sampling, determine the type of collection media required and an analytical laboratory. The Laboratory can provide this information. This specialized equipment is available through the Laboratory and CALICO with accompanying instructions.

MAINTENANCE

The sampler should be decontaminated prior to use by sterilizer or chemical decontamination with isopropanol.

G. RADIATION MONITORS AND METERS

LIGHT

Description And Applications

The light meter is a portable unit designed to measure visible, UV, and near-UV light in the workplace. A series of interchangeable filters and diffusers with a hand-held photodetector measures workers' exposure to light in the near-UV range (320-400 nm), the normal range, and in the actinic UV range (200-315 nm).

The light meter is capable of reading any optical unit of energy or power level if the appropriate detector has been calibrated with the meter. The spectral range of the instrument is limited only by the choice of detector.

Steady-state measurements can be made from a steady state source using the "normal operation" mode. Average measurements can be obtained from a flickering or modulated light source with the meter set in the "fast function" position. Flash measurements can be measured using the "integrate" function.

Calibration

No field calibration is available. These instruments are generally very stable and require only periodic calibration at a laboratory. Consult with CALICO.

Special Considerations

Exposure of the photomultiplier to bright illumination when the power is applied can damage the sensitive cathode or conduct excessive current.

Maintenance

Little maintenance is required unless the unit is subjected to extreme conditions of corrosion or temperature. Clean the optical unit with lens paper to avoid scratching.

Detector heads should be recalibrated annually by the manufacturer only. All calibrations are NIST traceable.

The nickel-cadmium batteries can be recharged. Avoid overcharging, which will reduce battery life.

NONIONIZING RADIATION

Description And Applications

Broad-band field strength meters are available for measuring electromagnetic radiation in the frequency range from 0.5 MHz to 6,000 MHz. Each meter comes with probes for measuring either magnetic or electric field strength, batteries, headset, and carrying case.

This unit is designed for laboratory and field use to measure magnetic and electric fields near RF induction heaters, RF heat sealers, radio and TV antennas, or any other radio frequency sources.

Calibration

No field calibration is available. Periodic calibration by a laboratory is essential.

Special Consideration

All units have automatic zeroing. There is no need to place the unit in a zero-field condition to zero it.

All units have a peak memory-hold circuit that retains the highest reading in memory.

All units operate with either electric (E) or magnetic (H) field probes based on diode-dipole antenna design. Total field strength is measured at the meter regardless of the field orientation or probe receiving angle. The diode-dipole antenna design of the probe is much more resistant to burnout from overload than the thermocouple design of probes used with other meters.

Maintenance

No field maintenance is required other than battery-pack charging or replacement.

H. AIR VELOCITY MONITORS AND METERS

FLOW HOODS

Description And Applications

These instruments measure air velocities at air supply or exhaust outlets.

Calibration

No field calibration is available. Periodic calibration by a laboratory is essential.

Maintenance

These typically require little field maintenance other than battery-pack servicing and zero balancing of analog scales. (Check manufacturer's manual.)

THERMOANEMOMETER

Description And Applications

These instruments monitor the effectiveness of ventilation by measuring air velocities.

Calibration

No field calibration is available. Periodic calibration by a laboratory is essential. Consult CALICO.

Maintenance

These typically require little field maintenance other than battery-pack servicing and zero balancing of analog scales. (Check manufacturer's manual.)

OTHER VELOMETERS

Other velometers include rotating-vane and swinging vane velometers.

Note: Barometric pressure and air temperature should be noted when using air velocity meters.

I. NOISE MONITORS AND METERS

SOUND LEVEL METERS AND DOSIMETERS

Description and Applications

The sound level meter is a lightweight instrument for the measurement of sound pressure level (SPL) in decibels.

All ANSI-approved meters meet minimum requirements that include an A-weighted network, a slow-response meter characteristic, and a fully graduated scale with measurements ranging from 80 to 130 dBA.

The Type II meter is most frequently used. Applications are in worker exposure and noise evaluations.

Calibration

In normal operation, calibration of the instrument usually requires only checking. Prior to and immediately after taking measurements, it is a good practice to check the sound level of the instrument with a calibrator. As long as the sound level readout is within 0.2 dB of the known source, it is suggested that no adjustments to the calibration pot be made. If large fluctuations in the level occur (more than 1 dB), then either the calibrator or the instrument may have a problem.

Special Considerations

Always check the batteries prior to use. Use the microphone windscreen to protect the microphone when the wearer will be outdoors or in dusty or dirty areas. (The windscreen will not protect the microphone from rain or extreme humidity.)

Never use any other type of covering over the microphone (e.g., plastic bag or plastic wrap) to protect it from moisture. These materials will distort the noise pickup, and the readings will be invalid.

Never try to clean a microphone, particularly with compressed air, since damage is likely to result. Although dirt and exposure will damage microphones, regular use of an acoustical calibrator will detect such damage so that the microphones can be replaced.

Remove the batteries from any meter that will be stored for more than 5 days. Protect meters from extreme heat and humidity.

Maintenance

No field maintenance is required other than replacement of batteries.

Annual maintenance and calibration is performed by CALICO.

PERSONAL DOSIMETERS

Description And Applications

These meters can be worn by personnel to obtain individual readings of noise exposure.

Typical dosimeters consist of a pocket-sized monitor with remote microphone and an indicator for readout of exposure data. Some have a preset threshold; others have a selector switch that my be preset.

Calibration

Field calibrate at the measurement site according to the manufacturer's instructions both before and after each use.

Use an acoustical calibrator that was designed to be used with the particular model noise dosimeter being used.

Special Considerations

Always check the batteries prior to use.

Be very careful with the microphone cable. Never kink, stretch, pinch, or otherwise damage the cable.

Use the microphone windscreen to protect the microphone when the wearer will be outdoors or in dusty or dirty areas. (The windscreen will not protect the microphone from rain or extreme humidity.)

Never use any type of covering over the microphone (e.g., plastic bag or plastic wrap) to protect it from moisture. Such materials will distort the noise pickup, and the readings will be invalid.

Never try to clean a microphone, particularly with compressed air, since damage is likely to result. Although dirt and exposure to industrial environments will damage the microphones, regular use of an acoustical calibrator will detect such damage so that microphones can be replaced.

Remove the batteries when the dosimeter will be stored for more than 5 days. Protect dosimeters from extreme heat and humidity.

Maintenance

No field maintenance is required other than replacement of batteries.

Annual maintenance and calibration is performed by CALICO.

OCTAVE BAND ANALYZERS

Description and Applications

This instrument is used to make precise sound-level measurements and analyze the levels into octave bands using an octave band filter network. It is also valuable for the calibration of audiometers and to determine sources of noise contamination for possible control.

Calibration

Field calibrate at the measurement site according to the manufacturer's instructions before and after each use.

Use an acoustical calibrator designed for use with the model octave-band analyzer being used.

Special Considerations

Always check the batteries prior to use.

Use the microphone windscreen to protect the microphone when the meter will be outdoors or in a dusty or dirty area. (The windscreen will not protect the microphone from rain or extreme humidity.)

Never use any type of covering over the microphone (e.g., plastic bag or plastic wrap) to try to protect it from moisture. Such materials will distort the noise pickup, and readings will be invalid.

Never try to clean a microphone, particularly with compressed air, since damage is likely to result. Although dirt and exposure to industrial environments will damage the microphones, regular use of an acoustical calibrator will detect such damage so that the microphones can be replaced.

Remove the batteries when the dosimeter will be stored for more than 5 days. Protect dosimeters from extreme heat and humidity.

Maintenance

No field maintenance is required other than replacement of batteries.

Annual maintenance and calibration is performed by CALICO.

J. ELECTRICAL TESTING METERS

DESCRIPTION AND APPLICATIONS

Electrical testing meters include multimeters, clip-on current meters, megohmmeters, battery testers, ground wire impedance testers, 120-V AC receptacle testers, ground fault interrupt testers, electrostatic meters, and AC voltage detectors.

Multimeters can check for AC leakage, proper line voltage, batteries, continuity, ground connection, integrity of shielded connections, fuses, etc.

Other specialized equipment is described in Appendix I:3-3.

CALIBRATION

Few, if any, field calibrations are available. Check manufacturer's manual.

MAINTENANCE

No field maintenance is required other than battery-pack servicing.

K. HEAT STRESS INSTRUMENTS

DESCRIPTION AND APPLICATIONS

Heat-stress monitors are portable instruments used to measure environmental factors that may cause heat-related injuries.

Personal heat-stress monitors measure body temperature and sometimes heartbeat through sensor belts around the chest or ear-canal sensors.

CALIBRATION

Most calibration is done by a laboratory.

MAINTENANCE

Some field servicing is required (check manufacturer's manual).

L. BIBLIOGRAPHY

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APPENDIX I:4-1. CALIBRATION INTERVALS

Summary Listing of equipment serviced by the CALICO LAB.

Instrument Category		CALICO LAB Service Interval
Air Sampling Pumps		Send to CALICO Lab for repair
Air Sampling Pump Calibrators		
Gilibrators	1 year	Performance check
Air Velocity Monitors	2 years	
Battery chargers		Send to CALICO LAB for repair
Single & multi-unit chargers		
Dust Monitors	1 year	
Electrical Testers	2 years	
Gas Monitors	1 year	
Single & combination gases		
Heat Stress Monitors	1 year	
Light Meters	2 years	
Mercury Monitors		
Bacharach MV-2	1 year	
Jerome 400 series	1 year	Loan from CALICO LAB
Radiation Monitors (Non-ionizing)	1 year	
Respirators		
Fit Test	1 year	
PAPR	2 years	
Sound Instruments (all)	1 year	

APPENDIX I:4-2. PROCEDURES FOR RETURNING INSTRUMENTS TO CALICO LAB

Field

Routine maintenance and calibration "checks" are to be performed by IH/SE's **prior** to, and **post** use. Maintenance will consist of basic cleaning, decontamination, functionality and battery check as applicable. Calibration "checks are to be performed in accordance with the equipment specification with the reference media supplied (e.g. toxic gas, standard gas, noise-sound level calibrator, volume - volumetric standard, etc.) Failures will be reported to the CALICO Lab for advice.

CALICO Laboratory (Calibration and Inventory Control)

1. Equipment returned to CALICO due to **failure** will be evaluated for functionality, maintenance, repair, calibration and replacement.

2. Equipment deemed unserviceable, will be "surveyed and replaced".

3. Calibration of equipment will be scheduled and performed based on manufacturer's recommendations and information supplied from the OSHA Cincinnati Technical Center (CTC). Scheduling is generally a 1 or 2 year cycle for most electronic equipment. The calibration procedure includes response evaluation to reference standards with necessary adjustments, functionality evaluation and any necessary service.

4. Replacement of equipment will based on three parameters:

    a. Failure to function

    b. Obsolescence

    c. Age - based on history of the type of equipment, failures become economically burdensome.

For most electronic equipment, based on obsolescence and age factors, a (5) five year replacement schedule is estimated.

Never use a carrying case like a shipping case. Carrying cases should be carefully stuffed to avoid any instrument movement during shipping and securely packed in a cardboard box. Any instrument with gauges, meters, glass or plastic parts exposed should have special protection over or around these parts before final packing for shipment. If a case has been furnished with the instrument, the case should be used whenever the instrument is not actually being operated. The case provides necessary protection. Styrofoam packing, bubbled polyethylene film, or crumpled

newspaper may be used for packing. If instrument is shipped with batteries or battery pack inside, turn off all switches

All instruments need to be sent in their case, with all the accessories:

Alnor Instruments, Kurz Instruments, Quest Instruments, Bacharach or any instrument that has accessories.

All Hot Wire Anemometers:

Return with their probes. Instrument and probe serial numbers are usually the same. If not, try to match probes with Instrument.

SKC, Gilian, & Personal Sampling Pumps:

Return with battery packs. Several types of battery packs can be repaired.

Quest Sound/Noise Instruments:

Send all microphones, and all attenuators with the instruments.

Instruments, no longer being utilized:

Please send these instruments to the Lab for survey or replacement.

Those instruments not specifically listed should be shipped using the customary precautions. Contact CALICO LAB if you have questions about specific instruments.

State of California CALICO
LAB
Department of Industrial Relations Voice (510) 577-2479
Division of Occupational Safety and Health Fax (510) 577-2480
7700 Edgewater Drive, Suite 401
Oakland, CA 94621-3017

SERVICE REQUEST

FROM:
Office: _____ PCA Code: _____
Address: _____
_____ Index Code: _____
City: _____ Zip: _____
Voice: _____
Contact: _____ Fax: _____

Bar Code Calibrate Number	State ID # Serial #	Item Description Operating Problems	
Repair			

_____ I:4-28 _____
Signature of Sender Date Received by Date

APPENDIX I:4-3. INSTRUMENT CHART

Note: Brand names are for identification purposes only and do not imply approval or acceptance by the Division of Occupational Safety and Health.

PHYSICAL MEASUREMENTS

Instrument	Measured substance	Application	Brands
Air Sampling Pump			
Bulk Pump	asbestos	bulk sampling	GAST
Low Flow	air volume	air sampling	Gilian LFS-113, Dupont Alpha 1
High Flow	air volume	air sampling	Dupont P2500B SKC 224-PCX7 224-44XR Gilian HFS-513
Hand Pump	detector tubes	screening	Sensidyne Gastec Model 800, Draeger Models 31, Accuro 2000
Gilibrators	air pump calibration	pump calibration	Gilian
Electrical Tester	electricity	circuits	EZ Scan, Knopp K60 Wiggington, TIF Mitchell PL440 Voltector V11
Multimeters	electricity	circuits	Sperry SPR300, Fluke 75
Pressure gauge			Matheson
Soil Test Kit	soil quality	trenching, excavating	Torvane Brainard-Kilman
Heat Stress Meter	ambient (environmental) heat	foundries, furnaces, and ovens	Reuter-Stokes RSS-211D, 214DL, Metrosonics, YSI Metrologger
Photo-ionization	ionizable substances	indoor air quality, leaks, spills	HNU DL101, Photovac 10A10

| Instrument | Measured substance | Application | Brands |

Radiation Meter Non-ionizing	non-ionizing radiation	communications, microwaves, heaters	Holaday Narda
Noise Dosimeter	noise	noisy locations	Quest M27, Q300,
Sound Level Meter	noise	noisy locations	Quest 211, 215, 1700, 1800, 2700
Sound Calibrator	meter calibration	noise meters	Quest CA-12, 15, 22, 32 QC -10, 20
Gas & Vapor Meter			
Single-range meters	single gas	confined spaces	Draeger 190
	NO/NO_2 combustion		Energetics Ecolyzer, Interscan 1150
	CO_2	indoor air quality	YES 203
Dual-range meters	LEL, O_2	confined spaces	Scott Vapotester M6, D6, D16, Gastector 1314,
Triple-range meters	LEL, O_2, CO and/or toxics	confined spaces	ISC CMX 270, 271, LTX 310
Quad-range meters	LEL, O_2, CO and/or toxics	confined spaces	TMX 410/412
Infrared analyzer	CO, CO_2 organic substances	traces indoor air, leaks, spills	Foxboro MIRAN 1BX
Fibrous aerosol monitors	fibers in air	asbestos	MIE Miniram
Dust Monitor	respirable dust	mines, sandblasting, dusty operations	MIE Miniram, PDL10, PDM3
Dust Monitor	respirable dust, particles	indoor air, QNFT	TSI Portacount Models 8010, 8020, TSI 8550 IAQ Meter
Mercury vapor meter	Mercury	mercury plants, spills	Jerome/411, 431X, Bacharach MV-2, TLV
Light Meter	Light	indoor lighting UV exposure	Weston 614, 615, 703 - Davis Digital Sylvania DS2050
Biological Monitors			
Microbial Sampler	Microbes	Indoor air quality	Anderson, Biotest